APPENDIX 2: Draft AC 43–203

DRAFT

U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject:	Altimeter and Static System Tests and Inspections	**Date:** 2/4/99 **Initiated by:** AFS-300	**AC No:** 43-203C **Change:**

1. PURPOSE. This advisory circular (AC) provides information and guidance concerning acceptable means, but not the only means for testing altimeters and static systems. It also provides general information concerning the test equipment that should be used and precautions that should be taken when performing such tests. This revision clarifies the intent of testing, incorporates the information formerly found in Appendix E to Part 43, and updates the material and includes guidance on testing methods that can be used on the advanced air data equipment found in today's aircraft.

2. EFFECTIVE DATE. TO BE DETERMINED.

3. CANCELLATION. AC 43-203B, dated June 29, 1979, is canceled.

4. RELATED MATERIAL.

a. Sections 23.1325, 25.1325, 27.1325, 29.1325, 43.3, 43.5, 43.9, 91.213, 91.215, 91.411, and 145.4 of Title 14, Code of Federal Regulations (14 CFR).

b. AC 43-2B, Minimum Barometry for Calibration and Test of Atmospheric Pressure Instruments.

5. GENERAL.

a. Aircraft flying in controlled airspace under instrument flight rules are required by § 91.411 to have altimeter and static system tests.

b. Manufacturer's instructions for continued airworthiness acceptable to the Administrator may be used to test and inspect altimeter and static systems.

c. The static pressure systems should be tested and checked following any opening and closing of the static pressure system, except for the use of system drain and alternate static pressure valves. Following installation or maintenance on the automatic pressure altitude reporting system of the air traffic control (ATC) transponder where data correspondence error could be introduced, the integrated system should be tested and inspected.

d. All persons conducting altimeter tests should receive specialized training in the performance of the test and in proper use of the test equipment. The tests required by § 91.411 and the tests described above should be conducted by—

(1) The manufacturer of the aircraft on which the tests and inspections are to be performed;

(2) A certificated repair station properly equipped to perform those functions and holding at least one of the following:

(i) A Class I instrument rating.

(ii) A limited instrument rating appropriate to the make and model of altimeter to be tested.

(iii) A limited rating appropriate to the test to be performed.

(iv) An airframe rating appropriate to the aircraft to be tested.

(v) A limited rating for a manufacturer issued for the appliance in accordance with § 145.101(b)(4).

(3) A certificated and appropriately rated aircraft mechanic.

(4) A holder of a maintenance program as provided in 14 CFR part 121 or 14 CFR § 135.411(a)(2).

6. STATIC PRESSURE SYSTEM TEST PRECAUTIONS. A person conducting a static system pressure test should take the following precautions during static system tests:

a. Before any static system is tested, it should be determined that the design limits of the instruments attached to it will not be exceeded during the test. To determine this, it is necessary to locate and identify all instruments attached to the system. In addition to the altimeter, airspeed indicator, and rate of climb indicator, many airplanes use static pressure for the operation of autopilots, flight recorders, air data computers, altitude reporting digitizers, and other equipment. The use of a current static system diagram of the airplane involved may be helpful in locating all of the instruments. If a current diagram is not available, the instruments can be located by physically tracing the system.

b. Damage can occur to instruments connected to both the static system and pitot system when only the static system is evacuated. This procedure could result in exceeding the maximum design differential pressure of these instruments. One method to prevent this type of damage is to link the pitot and static systems when conducting static system checks. This should result in zero differential pressure regardless of the degree of static system evacuation. It should be noted that a leak in either system will be indicated on a test set.

c. Avoid disconnecting the test equipment plumbing from the aircraft or the test equipment while the static system is evacuated. The resultant sudden pressure change may damage both the test instruments and the aircraft instruments.

d. If blockage of the static lines is suspected, the lines should be purged before the static pressure system test is performed. Besides the obvious benefits of removing foreign objects from the lines, purging may keep such objects from entering the test equipment. Because

purging applies positive pressure to lines, the following precautions should be taken:

(1) Disconnect all instruments and air data sensors.

(2) Cap lines not being purged.

(3) Restrain hoses, which can whip because of purge pressure.

(4) Ensure lines are clear by feeling the discharge pressure at ports.

(5) Clean system drains and traps after purging the system, because they can act as a sump for foreign material.

7. STATIC PRESSURE SYSTEM TEST. Performance of a static pressure system test with all of the static instruments connected to the system will ensure that leaks have not been introduced at instrument connection points. Compliance with the requirements in § 91.411, governing the testing of altimeter and static systems, may be demonstrated by adherence to the following procedure when conducting a static pressure system test:

a. Visually inspect the ports, plumbing, accessories, and instruments connected to the static system and repair or replace those parts that are defective; for example, broken "B" nuts, cracked flare sleeves, deteriorated flexible tubing, or bad valves. Ensure there are no restrictions or trapped moisture in the static pressure system lines. Purge the system, if necessary, to remove foreign matter that may have accumulated in the tubing.

b. Check the static port heater, if applicable, to ensure proper operation by noting either an ammeter current deflection or that the static port gets hot to the touch.

c. Ensure that no alterations or deformations of the airframe surface have been made that would affect the relationship between air pressure in the static pressure system and true ambient static air pressure for any flight condition.

d. When an aircraft has more than one static system, test each system separately to ensure its independence and to ensure the leak rate for each system is within tolerances established in § 23.1325, § 25.1325, § 27.1325, or § 29.1325, as applicable.

e. Connect the test equipment directly to the static ports, if feasible. Otherwise, connect the test equipment to a static system drain or tee connection and seal off the static ports. If the test equipment is connected to the static system at any point other than the static port, it should be made at a point where the connection may be readily inspected for system integrity after the system is returned to its normal configuration. Remove all static port seals after completion of the static system test.

f. Test the alternate static system at a field elevation of +200 feet to ensure the selection valve, if applicable, functions. If the altimeter reading, when on the alternate static pressure system, differs from the reading of the altimeter, when on the primary system, by more than 50 feet, a correction card should be provided for the alternate static system. Reference §§ 23.1325, 25.1325, 27.1325, and 29.1325, as applicable.

g. For unpressurized aircraft, conduct the static pressure system proof test to the standards prescribed in § 23.1325(b)(2)(i) or § 25.1325(c)(2)(i), as applicable.

h. For pressurized aircraft, conduct the static pressure system proof test to the standards prescribed in § 23.1325(b)(2)(ii), § 23.1325(3), or § 25.1325(c)(2)(ii), as applicable.

(1) An accurate vacuum gauge referenced to atmospheric pressure and connected to the static pressure system may be used to measure the equivalent cabin differential pressure.

(2) Either the altimeter in the aircraft being tested or the altimeter in the test equipment may be used as a vacuum gauge provided that barometric pressure in inches of Mercury (Hg) is converted to pressure in pounds per square inch (psi). A convenient formula for this conversion is—

$$\text{psi} = \frac{\text{inches of Hg}}{2.036 \text{ inches of Hg/psi}}$$

(3) The following steps are suggested for using the altimeter as a vacuum gauge:

Step 1. Convert the actual local barometric pressure (not reduced to sea level) to psi.

Step 2. Subtract the approved maximum cabin differential pressure in psi from the actual local barometric pressure in psi obtained in Step 1 to obtain the test pressure.

Step 3. Convert the test pressure in psi obtained in Step 2 to inches of Hg, using the following formula:

Inches of Hg = psi x 2.036 inches of Hg/psi.

Step 4. The test pressure expressed in inches of Hg can be converted to test altitude using Table 1.

INSERT TABLE ONE HERE

EXAMPLES
Assuming an actual local barometric pressure of 25.39 inches of Hg and an approved maximum cabin differential pressure of 5.3 psi, the test pressure and test altitude would be determined as calculated below.

Step 1. $\text{psi} = \frac{25.39 \text{ inches of Hg}}{2.036 \text{ inches of Hg/psi}} = 12.47 \text{ psi}$

Step 2. 12.47 psi - 5.3 psi = 7.17 psi

Step 3. Inches of Hg = 7.17 psi x 2.036 inches of Hg/psi = 14.60 inches of Hg

Step 4. 14.60 inches of Hg = 18,600 feet altitude

8. ALTIMETER TEST PRECAUTIONS. In addition to the precautions listed for Static Pressure System Tests, a person testing an altimeter system should take the following precautions:

a. Altimeters using air data computers with associated computing systems or that incorporate air data correction internally should be tested in a manner and to specifications developed by the manufacturer that are acceptable to the Administrator. Aneroid type testers may not be suitable to test these digital systems.

b. The static leak test should be conducted first to ensure there are no static system leaks to influence altimeter indications.

c. The altimeter should be permitted to stabilize after a flight before being tested.

9. ALTIMETER TEST. Each altimeter system test and inspection required by § 91.411 should comply with the following:

a. The test may be conducted using portable test equipment or barometric test equipment as described in paragraph 10, Altimeter Test Equipment.

b. When vibration is applied to the instrument, ensure it is not of a magnitude that will mask a sticky altimeter.

c. At a minimum, the altimeter should be tested to the maximum operating altitude specified in the aircraft flight manual.

d. The following tests should not be conducted when the temperature is substantially different from an ambient temperature of approximately 25° Celsius, unless a Federal Aviation Administration-approved variation allowance is available for the specified condition.

(1) Scale error. With the barometric pressure scale at 29.92 inches of Hg, the altimeter should be subjected successively to pressures corresponding to the altitude specified in Table II up to the maximum normally expected operating altitude of the airplane in which the altimeter is to be installed. The rate of reduction in pressure should not exceed 20,000 feet per minute and should be reduced to within approximately 2,000 feet of the test point. The test points should be approached at a rate compatible with the test equipment. The altimeter should

be kept at the pressure corresponding to each test point for at least 1 minute, but not more than 10 minutes, before the test reading is recorded. The error at each test point should not exceed the tolerances specified in Table II.

TABLE II

Altitude	Equivalent pressure (inches of mercury)	Tolerance +/- (feet)
-1,000	31.018	20
0	29.921	20
500	29.385	20
1,000	28.856	20
1,500	28.335	25
2,000	27.821	30
3,000	26.817	30
4,000	25.842	35
6,000	23.978	40
8,000	22.225	60
10,000	20.577	80
12,000	19.029	90
14,000	17.577	100
16,000	16.216	110
18,000	14.942	120
20,000	13.750	130
22,000	12.636	140
25,000	11.104	155
30,000	8.885	180
35,000	7.041	205
40,000	5.538	230
45,000	4.355	255
50,000	3.425	280

(2) Hysteresis. The hysteresis test should begin (i) within 15 minutes of the altimeter's initial exposure to the pressure corresponding to the upper limit of the scale error test prescribed in paragraph 9(d)(1) above, and (ii) while the altimeter is at the upper limit of the scale error test pressure. Pressure should be increased at a rate simulating a descent rate of 5,000 to 20,000 feet per minute until within 3,000 feet of the first test point (50 percent of maximum altitude). The test point then should be approached at a rate of approximately 3,000 feet per minute. The altimeter should be kept at this pressure

for at least 5 minutes, but not more than 15 minutes, before the test reading is recorded. After the reading has been recorded, the pressure should be increased, in the same manner as before, until the pressure corresponding to the second test point (40 percent of maximum altitude) is reached. The altimeter should be kept at this pressure for at least 1 minute, but not more than 10 minutes, before the test reading is recorded. After the reading has been recorded, the pressure should be increased, in the same manner as before, until atmospheric pressure is reached. The reading of the altimeter at either of the two test points should not differ by more than the tolerance specified in Table II from the reading of the altimeter for the corresponding altitude recorded during the scale error test prescribed in paragraph 9(d)(1).

TABLE III — TEST TOLERANCES

Test	Tolerance (feet)
Case Leak Test	+/-100
Hysteresis Test: First Test Point (50 percent of maximum altitude)	75
Hysteresis Test: Second Test Point (40 percent of maximum altitude)	75
After Effect Test	30

(3) After effect. Within 5 minutes of the completion of the hysteresis test prescribed in paragraph 9(d)(2), the reading of the altimeter (corrected for any change in atmospheric pressure) should not differ from the original atmospheric pressure reading by more than the tolerance specified in Table III.

(4) Friction. The altimeter should be subjected to a steadily decreasing pressure at a rate of approximately 750 feet per minute. At each altitude listed in Table III, the change in reading of the pointers after vibration should not exceed the corresponding tolerance listed in Table IV.

TABLE IV – FRICTION

Altitude (feet)	Tolerance (feet)
1,000	+/-70
2,000	70
3,000	70
5,000	70
10,000	80
15,000	90
20,000	100
25,000	120
30,000	140
35,000	160
40,000	180
50,000	250

(5) Case leak. The leakage of the altimeter case when the pressure within it corresponds to an altitude of 18,000 feet should not change the altimeter reading by more than the tolerance shown in Table II during an interval of 1 minute.

(6) Barometric, scale error. At a constant atmospheric pressure, the barometric pressure scale should be set at each of the pressures (falling within its range of adjustment) listed in Table V and should cause the pointer to indicate the equivalent altitude difference shown in Table V with a tolerance of 25 feet.

TABLE V – PRESSURE-ALTITUDE DIFFERENCE

Pressure (inches of Hg)	Altitude Difference (feet)
28.10	-1,727
28.50	-1,340
29.00	-863
29.50	-392
29.92	0
30.50	531
30.90	893
30.99	974

e. Altimeters tested on the bench should be tested to the limit of their maximum range of indication.

f. The automatic pressure altitude reporting equipment test and ATC transponder system integration test should be conducted in accordance with paragraph 5(d). Measure the automatic pressure altitude at the output of the installed ATC transponder when interrogated on Mode C at a sufficient number of test points to ensure the altitude reporting equipment, altimeters, and ATC transponders perform their intended functions as installed in the aircraft. The difference between the automatic reporting output and the altitude displayed at the altimeter should not exceed 125 feet.

g. Comply with the provisions of § 43.9 as to the content, form, and disposition of the records. The person performing the altimeter tests should record on the altimeter the date and maximum altitude to which the altimeter has been tested and the persons approving the aircraft for return to service should enter that data in the aircraft log or other permanent record.

10. ALTIMETER TEST EQUIPMENT. Equipment, materials, and required tests for test equipment are specified in § 145.47. Persons authorized to perform these tests and inspections are specified in § 43.3. The following test equipment is acceptable for testing altimeters:

a. Mercurial, aneroid, or digital barometers maintained in accordance with AC 43-2B.

b. Test equipment (with appropriate correction card) maintained in accordance with § 145.47(b). It has been found that calibration checks of the test equipment in accordance with the following schedule provides a satisfactory level of performance:

(1) Each 6-calendar months, after initial calibration, the aneroid equipment should be checked for accuracy against—

(i) A standard derived from the National Institute of Standards and Technology;

(ii) A barometer described in paragraph 10(a); or

(iii) A standard provided by the equipment manufacturer.

(2) Before use, the equipment should be checked for proper operations within calibration limits at station pressure using a mercurial, aneroid, or digital barometer or in accordance with paragraph 10(b)(1)(ii) above.

(3) The 6-calendar months calibration period in paragraph 10(b)(1) may be extended provided the calibration records of the individual test equipment reflect continued accuracy and/or technical information/recommendations of the equipment manufacturer.

11. MAINTENANCE RECORD ENTRY. The following is an example of a permanent maintenance record entry that will be satisfactory for compliance with § 43.9:

Example: I certify that the altimeter and static system tests required by 14 CFR 91.411 have been performed. The altimeter was tested to _____ feet on (date of altimeter test)
Signature _____
Date (of static system test) _____
Certificate Number _____

[Name]
[Title], [Office]